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AUTHOR Peterson, Carole; Parsons, Tina
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ABSTRACT

This study investigated children's memory of stressful, personally meaningful events--in this case, injury experiences. Children (2 to 13 years old) who were brought to the emergency room of a hospital were recruited as subjects if they had sustained trauma injuries such as broken bones or lacerations requiring suturing. A total of 42 were interviewed within a few days about both the injury and subsequent hospital treatment, and then re-interviewed again at 6 months, 1 year, and 2 years following the incident. To learn the details of the children's injuries, adult witnesses were also interviewed, and their accounts (along with hospital records) were used as the "gold standard" against which the children's recalls were compared for accuracy. Adult witnesses who knew the children well also rated the degree of stress experienced by the children. Results of the study showed that children had excellent long-term memory for their experiences, especially for central (rather than peripheral) details. Also, stress did not affect long-term recall. These findings suggest that the credibility of children's eye-witness testimony to emotionally disturbing events should not be considered inherently weak. (Author/WJC)

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CHILDREN'S LONG-TERM MEMORY FOR INJURY

Carole Peterson and Tina Parsons

Memorial University of Newfoundland

Abstract

In this study, children's memory for injury experiences was investigated. Children (2 - 13 years) who were brought to the Emergency Room of a hospital were recruited if they had had trauma injuries such as broken bones or lacerations requiring suturing. They were interviewed within a few days about both injury and subsequent hospital treatment and then re-interviewed again at 6 months, 1 year, and 2 years following the incident. To find out the details of the children's injuries, adult witnesses were also interviewed and their accounts (along with hospital records) were used as the "gold standard" against which the children's recalls were compared for accuracy. Adult witnesses also rated the degree of stress experienced by the children. Children had excellent long-term memory for their experiences, especially for central (rather than peripheral) details. As well, stress did not affect long-term recall. Implications for eyewitness testimony are discussed.

Paper included in M-E. Pipe and G. S. Goodman (Chairs), Remembering Events from Childhood: The Effect of Long Delays, symposium presented at the biennial meetings of the International Society for the Study of Behavioural Development, August 14, 1996, Quebec City, Quebec.

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Correspondence should be addressed to Carole Peterson, Psychology Department, St. John's, Newfoundland Canada A1B 3X9. E-mail address: carole@play.psych.mun.ca

INTRODUCTION

In this study, children's memory for stressful, personally meaningful events is investigated. It is clearly unethical as well as extremely undesirable to deliberately cause pain and high levels of distress in children just so one can investigate their memories. In the present research, we studied children who experienced such pain and stress, but we had nothing to do with causing it. We took advantage of a naturally-occurring phenomenon, namely the tendency of children to injure themselves in the ordinary course of their lives, sometimes seriously enough to require hospital Emergency Room treatment. They break bones, need stitches, and get bitten by dogs. To recruit subjects, research assistants sat in the Emergency Room of a children's hospital and waited for these children to come in. In order to discover the details of what happened, we interviewed adult eyewitnesses. Although it is possible that occasional errors were made by witnesses, they never disagreed with each other and their information became the "gold standard" against which the children's recalls were compared.

One focus of this research was how well children remember the details of their experiences as time goes by. In an earlier report (Peterson & Bell, in press), we discussed children's recall both within a week of the events and 6 months later. However, it is crucial that the children's memories be investigated over longer periods of time. In this study, children were re-interviewed both one year and two years after their injuries occurred, and this report presents data from their 2-year follow-up interviews.

A second focus of this research is the type of details that children either remember or forget. Much previous research finds that central information is remembered better than peripheral information. However, there is a distressing lack of consistency in how different investigators define central versus peripheral information. In the conclusion of a review on adult memory, Christianson (1992) differentiates three categories: central vs. noncentral details within an emotional scenario vs. details of events preceding or succeeding the emotional scenario. This 3-way division is what we use here. The children's injuries and their hospital treatment were the emotionally-arousing, key events. But the children also had other experiences that were outside of

these two emotional highpoints, namely their trip to the hospital, their wait in the waiting room and their post-hospital experiences. Details of these latter experiences that occurred outside of the key emotional events were defined as Peripheral-Outside. For items that occurred inside them we adapted the plot-relevant versus plot-irrelevant criteria of Heurer and Reisberg (1990) in order to differentiate Central-Inside from Peripheral-Inside details. Everyone would agree that what we termed "central" is indeed central, and likewise everyone would also agree that what we call "peripheral-outside" is indeed peripheral. The disagreement lies in the category "peripheral-inside"; some researchers would consider such details central and others would consider them peripheral. Here, they are in a separate category. In the earlier 6-month follow-up report, we found that children recalled central details better than peripheral-inside details, and these in turn were recalled better than peripheral-outside details. Is this pattern still true after 2 years?

A third focus of this research is the degree to which stress affects children's memory. A common belief among eyewitness memory experts is that highly stressful events are remembered more poorly than are less stressful events. Christianson (1992) reviewed reseaarch on adults and found that this belief was unfounded. Instead, higher stress led to better recall of central details but poorer recall of peripheral details. When one turns from adult research to child research, findings get more confused. Some studies find better memory for stressful events and others find poorer memory and still others find no relationship at all. (See Peterson & Bell, in press.)

In the current study, we assessed stress level by having adult eyewitnesses who knew the children well (mostly parents) rate the children's degree of distress at both the time of injury and during hospital treatment. The question we asked was this: does stress mediate forgetting over long delays? That is, do children who were more distressed forget less or forget more as years go by than do children who were less distressed? And does the type of detail interact with stress in ways similar to adult research findings?

METHOD

Data from 42 children are included in this report, 14 in each of three age groups: 2-3 year olds (mean age 3.0), 4-5 year olds (mean age 5.1), and 9-13 year olds (mean age 11.0). They were

interviewed in their own homes using free and probed recall about both their injury and hospital experiences. This report presents data from their interviews conducted within a week of their injury, 6 months later, and 2 years later. Although they were also visited and reminded of their injury at 1 year, that data was not available at this time. Prior to each visit, parents were asked not to rehearse the events with their children. During the first visit, parents and other witnesses were also interviewed about the relevant events, and they were also asked to rate the children's degree of distress on a scale of 1 to 6, with 1 being "not at all distressed" and 6 being "extremely distressed." They did this for both of the episodes that caused the children pain and distress, that is, for both the injury and medical treatment. The children's stress ratings at the two times were often quite different and in fact were not significantly correlated.

RESULTS

All the children's experiences were unique in some respects; nevertheless, they also shared many common elements. That is, they all fit a prototypical pattern with some elements optional. To equate the children's recall data as much as possible, this prototype pattern was the basis for probed questioning. If information about each element of the prototype was not volunteered in free recall, the children were specifically asked about it. These prototype elements include where the child was, who was with them, when it occurred, what object did the physical damage to their body, and so on. (The elements of this prototype are provided in the Appendix.) The children's interviews were transcribed and the transcripts scored for the number of elements of this prototype that potentially could have been recalled by each individual child which were in fact actually recalled, and recalled correctly. Thus, the data are the percentage of relevant elements of this prototype that were accurately remembered.

The percentage of elements correctly recalled by the children was analyzed in a multivariate analysis of variance, with age (3 levels) a between-subject factor and time (3 levels) a repeated measure. There were also two within-subject factors: episode (injury vs. hospital) and detail (central vs. peripheral-inside vs. peripheral-outside).

All four factors were significant main effects: (1) Age was significant, $F(2, 39) = 33.41$, $p < .001$, with the oldest children recalling more than the 4-5 year olds, who in turn recalled more than the 2-3 year olds. (2) Time was significant, $F(2, 38) = 5.43$, $p = .008$. Not surprisingly, the children recalled the most in the first interview; however, there was no difference in how much they recalled 6 months later and 2 years later. (3) Episode was significant, $F(1, 39) = 6.92$, $p = .012$, with children recalling more about their injury than their hospital treatment. (4) Detail was significant, $F(2, 38) = 93.27$, $p < .001$; central details were recalled more than peripheral-inside details, which in turn were recalled more than peripheral-outside details.

However, these main effects were complicated by two 2-way interactions and one 3-way interaction. There was a significant interaction between time and episode, $F(2, 78) = 3.48$, $p = .036$; in general, children recalled less 6 months later than they did during their initial interviews but 2 years later they are recalling just as much about their injury as they did initially while their recall of the hospital episode continued to decline (Figure 1). There was also a significant 2-way interaction between episode and information, $F(2, 38) = 6.62$, $p = .003$ (Figure 2). More central information is recalled about the injury than about the hospital, but the two categories of peripheral detail do not differ between the two episodes. Thus, injury central details seem to be particularly salient to the children. Both of these 2-way interactions were complicated by a significant 3-way interaction between time X episode X information, $F(4, 36) = 4.07$, $p = .008$. (see Figure 3). In terms of their memory of their injury, it is the recall of details that occur within the injury scenario, namely central and peripheral-inside details, that rebounds at 2 years, not injury peripheral-outside details. In contrast, their recall of their hospital experiences continues to decline. The decreased recall of hospital details is easy to understand; with the passage of time, more is forgotten. But why does recall of injury details rebound? Perhaps this is the episode that gets rehearsed more during casual conversation. All of the parents said that they had not talked about these experiences for months before each interview (except the initial one of course). They were, after all, "old news." But the children have peers who undoubtedly are also injuring

themselves, and perhaps when this happens the children are reminded of their own injury and compare notes.

We were also interested in how accurate the children's recall was of the relevant items that we analyzed above. To calculate this, we looked at the number of accurate relevant elements provided by the children and then divided this number by the total of relevant pieces of information. Thus, we have a percentage accuracy score: what percentage of the relevant elements that they provided was correct? Not surprisingly, older children were more accurate than were younger children, $F(2, 39) = 17.10$, $p < .001$. But it is important to realize that most of the details produced by all age groups were still accurate. In addition, more errors were made with time, $F(2, 38) = 24.58$, $p < .001$. And children were more accurate when recalling their injury than the hospital episode, $F(1, 39) = 14.53$, $p < .001$. However, this was complicated by an interaction between time and episode, $F(2, 38) = 11.70$, $p < .001$. (See Figure 4). Children's accuracy rate declined slowly for injury details whereas it declined much more steeply for hospital details. By the end of two years, their error rate was more than twice as high when recalling the hospital rather than the injury.

We analyzed the effects of stress by calculating Pearson product-moment correlations between each of our two stress levels and children's recall of every category of information as well as their error rates. In an earlier report we found that stress had little impact on children's recall either immediately or 6 months later (Peterson & Bell, in press). It also had no impact on children's recall 2 years later. Because age was significantly correlated with hospital stress (but not injury stress), we also calculated partial correlations, with age partialled out. Again, stress was not important.

DISCUSSION

There were three questions that directed this research.

(1) How well do children remember salient, stressful events two years later? The answer is that they remember them quite well. As well, the older the child is at the time of injury, the better their long-term recall. But even preschoolers as young as 2 and 3 years of age can recall these

events for a very long period of time. Interestingly, the injury experience was recalled better after a long delay than was the hospital treatment. It was also recalled more accurately. Perhaps the particular events of the hospital become integrated into a script over time - after all, lacerations uniformly get sutures, broken bones get casted, and there is a lot that is not especially unique about any particular child's hospital experience. They also have other experiences with the hospital since they are also taken there for illness, minor injuries that we did not include, and so on. So a trip to the hospital is not a unique experience. In contrast, the circumstances of an injury that is so severe that it requires an immediate trip to the Emergency Room is unique.

(2) Does the type of detail, namely whether it is central vs. peripheral but inside the emotional scenario vs. peripheral and outside of the emotional scenario make a difference? Yes it does. Central details are recalled better than either type of peripheral detail. And details that were associated with events that are outside of the key emotional scenarios, that is, events that preceeded or followed the emotionally-laden events, are recalled the worst. Thus, our data suggest that a division of information into three categories, with peripheral details differentiated on the basis of whether they occurred within or outside of an emotional scenario, may be more appropriate than a simple 2-way division into central versus peripheral.

(3) Does children's stress level at the time of injury affect their long-term recall of those distressing events? The answer seems to be "no." That is, children who were highly distressed and those who were considerably less so remembered just as much. This is a very interesting finding because some of these children were absolutely hysterical at the time these events occurred. Some were extremely frightened, were experiencing considerable pain, and crying very hard. Nevertheless, they could still report on these distressing events just as well as if they were not so emotionally involved in them. So high stress levels did not seem to compromise their encoding, storage or retrieval of relevant information.

These findings have implications for children's eyewitness testimony. Children can remember salient personal events over a long period of time. Others have shown that children can recall museum trips, fire alarm evacuations, and staged events over several years (Hudson &

Fivush, 1991; Pillemer, Picariello & Pruett, 1994; Poole & White, 1993). This suggests that even events that were very distressing at the time they occurred can also be recalled long-term. Thus, the fact that children are highly emotionally involved and experience very negative affect during an experience does not in itself make their testimony less credible.

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Appendix

Prototype Of Injury And Hospital Treatment With Examples Of Items And Classification Category As Central-Inside (C), Peripheral-Inside (P-In), Or Peripheral-Outside (P-Out) Detail

Item	Example	Category
	THE INJURY	
Time of day	"Right after lunch"	P - In
Place	"In my backyard"	P - In
Who was with you	"Mom and my brother Joe"	P - In
Who else was around	"My friend Anna was playing there too"	P - In
Actions prior to injury	"I was running"	P - In
The injury	"I got a big cut on my leg"	C
How it occurred	"I was tripped"	C
Who did it	"By my brother"	C
What objects involved	"I hit a piece of the porch that was sticking up"	C
Cry	"I had to just scream"	C
Blood	"It was bleeding all down my leg"	C
Who first responded	"Mommy heard me cry"	C
Where you went before hosp.	"She took me into the kitchen"	P - In
Actions to treat injury	"She wiped my knee"	C
Objects of home treatment	"And put a cloth on my knee to soak up blood"	C
Anyone else look/help?	"My brother was watching"	P - In
Went to hospital	"Then I went to the hospital"	C
Who took you to hospital	"Mom drove me there"	P - Out
Who else went along	"My brother had to come too"	P - Out
Time of hospital trip	"We got to the hospital half an hour later"	P - Out

THE HOSPITAL TREATMENT

Registration	"A nurse checked me in"	P - Out
Vitals measured	"I got my blood pressure taken"	P - Out
Waiting period	"I had to wait a long time"	P - Out
Actions while waiting	"I watched the TV"	P - Out
Initial exam	"Finally somebody looked at my cut"	C
Hospital personnel	"It was a girl doctor"	C
X-rays	"I got an X-ray because they thought something was still in my knee"	C
Cast	(not relevant)	C
Needles	"I got 4 needles to put my knee asleep"	C
Stitches	"And then I got 14 stitches"	C
Bandage	"I got a big bandage all down my leg"	C
Procedural details	"The doctor washed out my cut first"	P - In
Other treatment objects	"With soap"	P - In
Cry	"That made me cry"	C
Popsicle	"The nurse gave me a yellow popsicle "	P - In
Family in treatment room	"My Mom was in there with me"	P - In
Went home	"We went home"	P - Out
Stopped somewhere on way	"On the way we stopped at McDonald's"	P - Out
Post-hospital treat	"Mom got me some fries"	P - Out
Who you told/showed	"I called my Dad and my Nana and told them"	P - Out

PERCENTAGE OF ELEMENTS RECALLED

Figure 1: Time X Episode

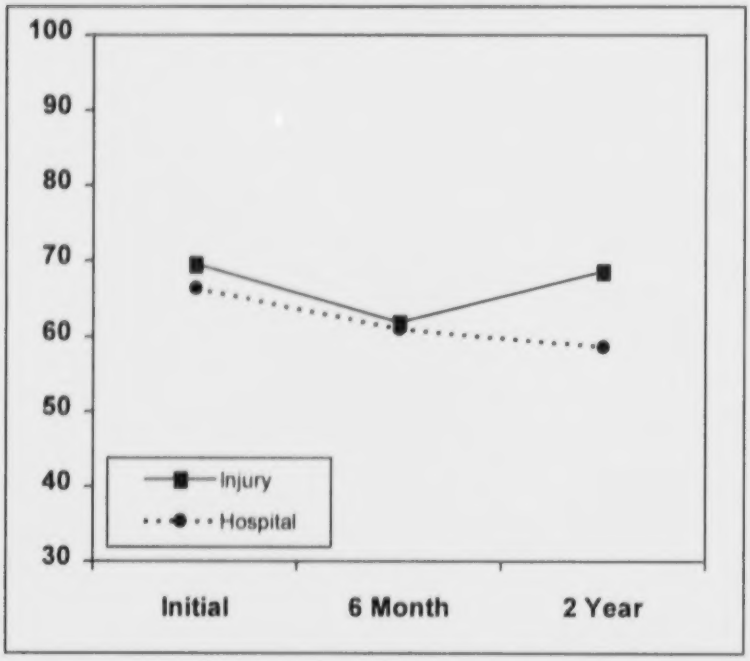
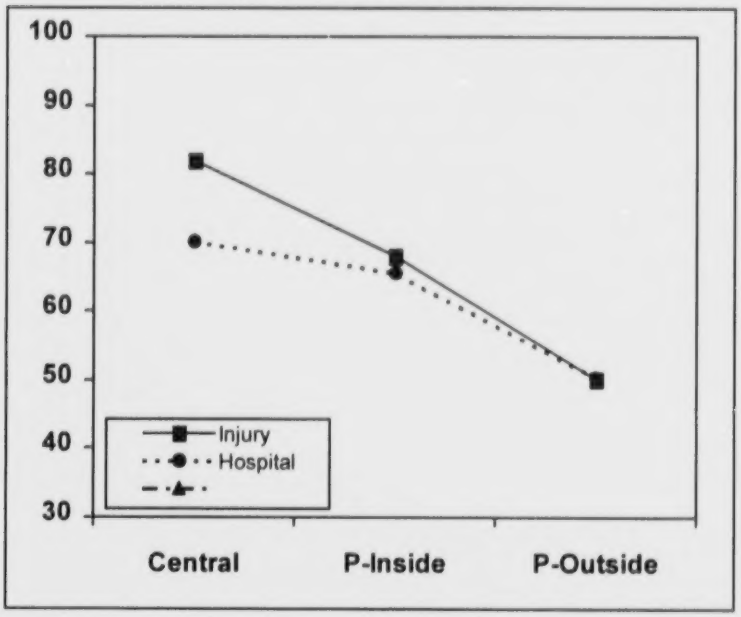


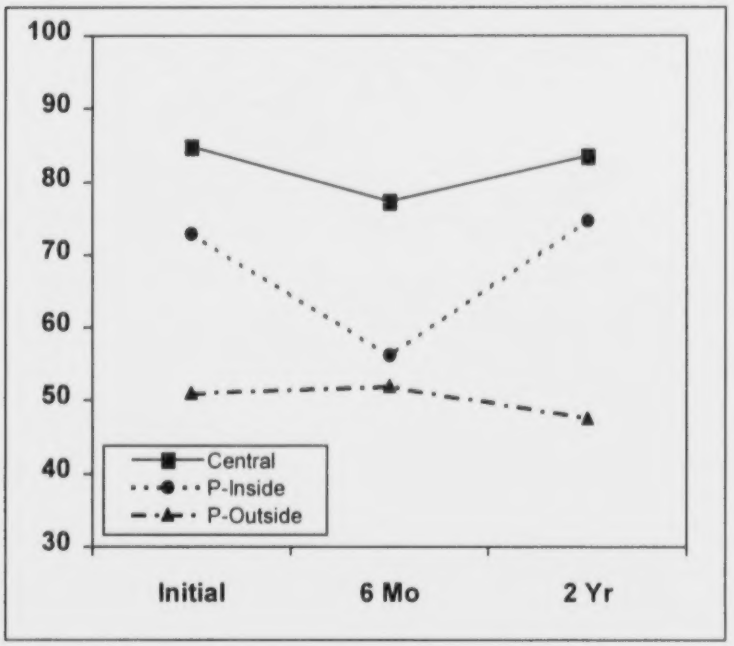
Figure 2: Episode X Detail



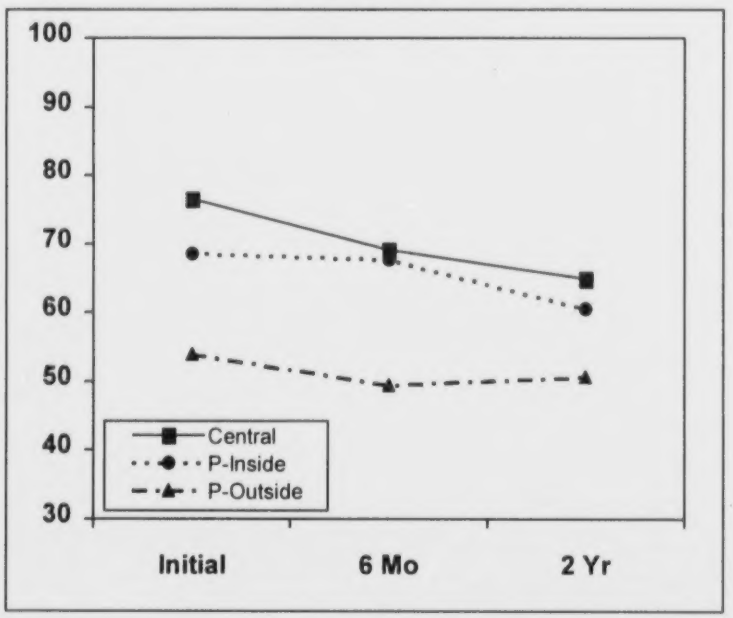
PERCENTAGE OF ELEMENTS RECALLED

Figure 3: Time X Episode X Detail

INJURY



HOSPITAL



PERCENTAGE OF RECALLED ITEMS THAT ARE ACCURATE

Figure 4: Time X Episode